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Does the Climate Regime Need New Types of Mitigation Commitments?

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Abstract

Apart from the much-debated question of what legal form the 2015 climate agreement is supposed to have, another core issue is the substantive content of countries' commitments. While the climate regime has so far mostly been based on emission targets, literature has identified a broad range of other possible types of mitigation commitments, such as technology targets, emission price commitments, or commitments to specific policies and measures (PAMs). The nationally appropriate mitigation actions (NAMAs) submitted by developing countries under the Cancún Agreements also show a broad range of different forms of participation. This article surveys the possible commitment types that have so far been discussed in literature and in the UNFCCC negotiations and assesses their respective advantages and disadvantages against a set of criteria: environmental effectiveness, cost effectiveness, distributional aspects and institutional feasibility. The article finds that no commitment option provides a silver bullet. All options have several advantages but also disadvantages. The environmentally most effective way forward may lie in pursuing a multi-dimensional approach, combining emission targets with other commitment types to compensate for the drawbacks of the emission-based approach. However, such an approach would also increase complexity, both in terms of the negotiations and in terms of implementation and administration.

I. Introduction

The Ad Hoc Working Group on the Durban Platform for Enhanced Action (ADP) aims to "develop a protocol, another legal instrument or an agreed outcome with legal force under the Convention applicable to all Parties", which is to be adopted in 2015 and to be implemented from 2020.[1] Apart from the much-debated question of what legal form the new agreement is supposed to have, another core issue is the substantive content of countries' commitments.[2] Key variables that define the substantive content of environmental agreements are the type, scope and differentiation of commitments.[3] The 2015 agreement may potentially include commitments on climate change mitigation, adaptation and on provision of financial,

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[1] Decision 1/CP.17, Establishment of an Ad Hoc Working Group on the Durban Platform for Enhanced Action, UN doc. FCCC/CP/2011/9/Add.1, 15 March 2012.

[2] In the latest ADP decision Parties chose to avoid the term "commitments" and instead referred to "contributions". As the ultimate legal nature of these contributions is yet to be determined, this article nevertheless uses "commitments" as probably being the generally most easily understood term.

[3] Daniel Bodansky, *The Durban Platform: Issues and Options for a 2015 Agreement* (Arlington, Va.: Center for Climate and Energy Solutions, 2012), at 4.

technological and capacity building support. This article explores options in the area of mitigation.

While mitigation commitments have so far mostly been based on emission targets, literature has identified a broad range of other possible types of mitigation commitments, such as technology targets, emission price commitments, or commitments to specific policies and measures (PAMs).[4] The analysts usually start from the (real or perceived) weaknesses of the Kyoto Protocol model and on this basis try to develop regime designs that in their view hold more promise for concluding an effective and equitable climate agreement. Within the actual negotiations, the nationally appropriate mitigation actions (NAMAs) submitted by developing countries under the Cancún Agreements also show a broad range of different forms of participation. Beside various forms of country-wide emission targets – absolute, intensity-based or defined as deviation from business as usual – some countries have also pledged sectoral targets, targets for specific technologies or lists of individual projects.[5]

This article aims to survey the possible mitigation commitment types that have so far been discussed in literature and in the UNFCCC negotiations and to assess their respective advantages and disadvantages against a set of criteria. The article uses the four criteria for the evaluation of climate policy instruments and international arrangements as applied by the IPCC's Working Group 3 in the Fourth Assessment Report:[6]

- Environmental effectiveness: According to the IPCC, "Policies that achieve specific environmental quality goals better than alternative policies can be said to have a higher degree of environmental effectiveness."[7] However, to avoid dangerous climate change is not a "specific environmental quality goal". To gauge the effectiveness of different types of commitments it is therefore necessary to define a more precise environmental goal against which the respective commitment types can be evaluated. On a global scale such a goal could for example be to completely phase out anthropogenic GHG emissions by 2050.[8]
- Cost-effectiveness: In a world with scarce resources the estimated cost of a policy instrument is key. We will therefore evaluate the extent to which an instrument promises to achieve the environmental objective at a minimum cost to society. This includes not only direct costs and transaction costs such as impacts of administering and implementing an instrument but also dynamic cost-effectiveness, that is, how well an instrument drives cost-reducing technological change. This criterion takes the environmental objective as given. By contrast, according to the definitions of IPCC Working Group 3 economic efficiency, which is often used as an evaluation criterion, also involves variation of the goal itself in order to maximise the balance of costs and benefits.

[4] The various proposals have for example been synthesised in Joseph E. Aldy, J, Scott Barrett and Robert N. Stavins, "Thirteen Plus One: A Comparison of Global Climate Policy Architectures", 3 *Climate Policy* (2003), 373; Cédric Philibert, *Approaches for Future International Co-operation* (Paris: Organisation for Economic Development and Cooperation/International Energy Agency, 2005); Sujata Gupta et al., "Policies, Instruments and Co-operative Arrangements", in Bert Metz et al. (eds.), *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* (Cambridge: Cambridge University Press, 2007); Onno Kuik et al., "Post-2012 Climate Policy Dilemmas : A Review of Proposals", 8 *Climate Policy* (2008), 317.

[5] UNFCCC, Compilation of Information on Nationally Appropriate Mitigation Actions to be Implemented by Developing Country Parties, UN Doc. FCCC/SBI/2013/INF.12/Rev.2, 28 May 2013.

[6] Unless indicated otherwise, the entire following list of criteria and their definitions is based on Gupta et al., "Policies, Instruments and Co-operative Arrangements" supra, note 4, at 751f.

[7] Ibid., at 751.

[8] Eric Haites, Farhana Yamin and Niklas Höhne, *Possible Elements of a 2015 Legal Agreement on Climate Change* (Paris: IDDRI, 2013).

- Distributional considerations: In order to achieve the necessary emission reductions countries will have to fundamentally restructure their economies. This will not go without distributional effects, that is, there will be winners and losers. This comprises both an international as well as an intra-national perspective, that is, various types of commitments can shift both assets and income among as well as within countries. Under this criterion, we will investigate the extent to which a proposal can be expected to have distributional consequences, which includes dimensions such as fairness and equity. In political discussions distributional impacts are often more important than aggregate cost-effectiveness.
- Institutional feasibility: Not losing track of the realpolitik of climate change mitigation we will finally consider the extent to which a proposal is likely to be viewed as legitimate, gain acceptance, be adopted and implemented, which includes political as well as administrative and technical aspects of feasibility. Policy choices must be acceptable to a wide range of stakeholders and be feasible in terms of human capital and infrastructure. Acceptability is often strongly influenced by culture and traditions as well familiarity with a certain type of instrument.

Other criteria that are often used such as impacts on competitiveness are subsumed within these four.

In the following, the article first lays out the various commitment options that have so far been discussed in literature and in the negotiations. Second, the article assesses the core options qualitatively against the criteria listed above.

The analysis finds that no option provides a silver bullet. All options have several advantages but also disadvantages. The environmentally most effective way forward may lie in pursuing a multi-dimensional approach, combining emission targets with other commitment types to compensate for the drawbacks of the emission-based approach. However, such an approach would also increase complexity, both in terms of the negotiations and in terms of implementation and administration.

II. Types of Mitigation Commitments

Commitment types may be grouped into two main categories: they may be "obligations of result" or "obligations of conduct".[9] That is, commitments may refer to what countries are supposed to achieve or to what they are supposed to do. While the climate regime has so far mostly focused on emission results, the World Trade Organisation (WTO) is one example that prescribes desired conduct rather than desired results. The WTO regulates its member states' trade-related policies at a very high level of prescriptive detail, for example allowable tariff levels, allowable types and levels of subsidies, minimum rules for the protection of intellectual property, or rules for government procurement.[10]

Within these two basic types there exist different sub-types. For example, result-based mitigation commitments may not only relate to emissions, but also to interrelated outcomes that are not directly linked to but relevant for emission levels, such as the energy intensity of the economy, the emission intensity of energy supply, or market shares of specific technologies such as renewables. Conduct-based commitments may relate to concrete policies and measures, such as levying specific taxes and fees, imposing specific performance

[9] Bodansky, *Issues and Options for a 2015 Agreement*, supra, note 3, at 4.
[10] For a comparison and discussion see e.g. David Victor, *Global Warming Gridlock. Creating More Effective Strategies for Protecting the Planet* (Cambridge et al.: Cambridge University Press, 2011).

standards, offering specific financial support for investments, or even specific individual projects and programmes. Emission price commitments as proposed by some authors can principally be considered result-based as well, albeit with a much more restricted range of options to achieve the committed outcome. Hence, they fall somewhat in the middle of the two categories.

The following sections give an overview of the main proposals of types of commitments that have been suggested in literature.

1. Result-Based Commitments

a. Economy-wide GHG Emission Limitation/Reduction Targets

Economy-wide emissions are typically limited either in absolute terms as in the Kyoto Protocol or relative to a certain index such as GDP or to business as usual as in a number of NAMAs submitted under the Cancún agreements. So far absolute targets have usually been defined in relation to a historical reference year. There are various proposals to define national targets top-down in the future, for example Contraction and Convergence,[11] the Greenhouse Development Rights Framework,[12] or the Budget Approach,[13] to name just a few. With these approaches, in the first step a global emission trajectory or budget would be defined, and in the second step country shares would be allocated according to a set of equity criteria to be agreed internationally.

b. Sectoral Emission Limitation/Reduction Targets

Instead of being economy-wide, emission targets may also be adopted for individual sectors. Possibilities for scaling up the CDM to the sectoral level or introducing new mechanisms that would be based on sectoral targets have been discussed for more than 10 years.[14] While many envisage that sectoral targets would be determined by the respective country, there has also been some discussion about introducing transnational sectoral approaches/agreements, wherein internationally uniform benchmarks would be agreed for specific sectors.[15] The most far-reaching proposal suggests that countries should disaggregate the entirety of their national emissions and commit to separate targets for each non-CO_2 gas and to separate targets for each CO_2-emitting sector.[16]

c. Targets for Interrelated Results

In addition to or as replacement of emission targets, countries may set targets for interrelated results that have a bearing on emissions, such as the energy intensity of the economy or the CO_2 intensity of energy provision. The EU provides a real-life illustration of this approach

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[11] Global Commons Institute (GCI), *GCI Briefing: Contraction and Convergence* (Global Commons Institute, 2005), available on the Internet at <www.gci.org.uk/briefings/ICE.pdf> (last accessed on 13 November 2013).
[12] Paul Baer, Tom Athanasiou and Sivan Kartha, *The Right to Development in a Climate Constrained World: The Greenhouse Development Rights Framework* (Berlin: Heinrich Böll Foundation, 2008).
[13] German Advisory Council on Global Change (WBGU), *Solving the Climate Dilemma: The Budget Approach* (Berlin: WBGU, 2009).
[14] Starting with José Samaniego and Christiana Figueres, "Evolving to a Sector-Based Clean Development Mechanism", in Kevin A. Baumert et al. (eds.), *Building on the Kyoto Protocol: Options for Protecting the Climate* (Washington, DC: World Resources Institute, 2002), 89.
[15] An overview and taxonomy of sectoral approaches proposed to date is provided by Jonas O. Meckling and Gu Yoon Chung, "Sectoral Approaches for a Post-2012 Climate Regime: A Taxonomy", 9 *Climate Policy* (2009), 652.
[16] See e.g. Scott Barrett and Michael Toman, "Contrasting Future Paths for an Evolving Global Climate Regime", 1 *Global Policy* (2010), 64.

with its (internal) "20-20-20 targets" for greenhouse gas emissions, renewables and energy efficiency.[17] A number of current non-Annex I pledges contain targets for interrelated results. For example, China in addition to its emission intensity target also pledged to increase the share of non-fossil fuels in primary energy consumption to around 15% by 2020.[18]

2. Conduct-Based Commitments

a. (Packages of) Policies and Measures

Coordinating policies and measures (PAMs) was one plank of the original Kyoto negotiations in 1995-1997, but this process was not successful.[19] Some nevertheless argue that directly negotiating PAMs would be much more effective than negotiating emission targets.[20] Reinstein proposes that countries might adopt either emission targets or packages of PAMs, depending on their respective circumstances.[21] Winkler et al. propose that while industrialised countries should continue following the Kyoto model, stronger participation of developing countries should take the form of committing to certain sustainable development PAMs (SD PAMs) that promote development objectives while at the same time reducing emissions, e.g. low-energy social housing programmes.[22]

a Emission price commitments (possibly coordinated)

As a specific variant of the general PAM-based approach, some propose that countries should commit to imposing a certain price on their national emissions.[23] In a strict sense, an emission price as such is not directly linked to the implementation of a certain policy and hence is not a conduct-based commitment. However, the number of options for national implementation is much more limited as compared to an emission limitation/reduction commitment. There are basically two ways of ensuring an emission price: through a tax or through an emission trading system with a minimum allowance price. A price commitment insofar strongly presupposes a certain government conduct.

b. Commitment(s) for strategic technology advancement

As another variant of the general PAM-based approach, some proposals suggest to focus international climate policy on research, development and diffusion of climate-friendly technologies. Technology-oriented agreements may relate to collaborative research and development and/or to requirements for common standards for key technologies, such as performance standards for power and other industry plants, vehicles, fuel quality and others. Joint R&D and joint standard-setting may be implemented as a package, in particular to use standard-setting to promote the diffusion of the results of the joint R&D. Standards could be

[17] Brussels European Council, 8/9 March 2007, Presidency Conclusions, 7224/1/07, Rev 1, Concl. 1.
[18] UNFCCC, *Compilation of NAMAs*, supra, note 5.
[19] Michael Grubb, Christiaan Vroljik and Duncan Brack, *The Kyoto Protocol: A Guide and Assessment* (London: Royal Institute of International Affairs, 1999); Sebastian Oberthür and Hermann E. Ott, *The Kyoto Protocol: International Climate Policy for the 21st Century* (Berlin: Springer, 1999).
[20] E.g. Victor, *Global Warming Gridlock*, supra, note 10.
[21] Robert A. Reinstein, "A Possible Way Forward on Climate Change", 9 *Mitigation and Adaptation Strategies for Global Change* (2004), 295.
[22] Harald Winkler et al., "Sustainable Development Policies and Measures: Starting from Development to Tackle Climate Change", in Kevin A. Baumert et al. (eds.), *Building on the Kyoto Protocol: Options for Protecting the Climate* (Washington, DC: World Resources Institute, 2002), 61.
[23] E.g. Robert Cooper, "Towards a Real Treaty on Global Warming". 77 *Foreign Affairs* (1998): 66; Joseph E. Stiglitz, *Making Globalization Work* (New York and London: W W Norton & Co, 2006).

phased in over time, starting with new plants and later extension to existing plants, and phased application to different groups of countries.[24]

c. Individual actions and projects

While not discussed in the literature as a desirable type of commitments, many of the pledges submitted by non-Annex I countries under the Cancún Agreements are essentially lists of projects or activities.[25]

III. Evaluation of Options

1. Environmental Effectiveness

Emission targets, in particular absolute targets, whether economy-wide or sector specific, provide the highest ex-ante clarity about the envisaged environmental outcome (if accounting is done properly). However, this clarity is not to be mistaken for effectiveness, which depends on the stringency of the target. Hardly any country has thus far committed to sufficiently ambitious emission reductions.[26] Historically, some countries have been allowed substantial emission growth both under the Kyoto Protocol[27] and under the EU effort sharing agreement[28]. As result, the Kyoto Protocol's first commitment period will yield an estimated surplus of assigned amount units of 9-13 Gt CO_2-eq.[29]

Furthermore, if tradable and bankable as in the Kyoto approach, emission targets constitute not only the minimum but also the maximum emission reduction. This may block doing more in case the commitments do not meet the necessary level of ambition and/or reductions turn out to be easier than expected and may thus inhibit the development of a dynamic race to the top. One may perhaps draw an analogy to the impacts of feed-in tariffs and quota models for promoting renewables. Quotas give certainty on the outcome, but have not engendered anything close to the dynamics engendered by feed-in tariffs.[30]

Absolute emissions are influenced by a wide range of factors, some of which governments are better able to control than others. The higher the level of aggregation of a commitment, the larger is the set of influencing factors the committing country assumes responsibility for. And the more comprehensive this set of influencing factors is, the higher is the ex-ante clarity of the commitment in terms of measurable emission reductions. Therefore, relative emission targets do not provide the same ex-ante clarity as absolute emission reduction targets. The same is true for commitments on interrelated results. Measures such as energy intensity of the economy or emission intensity of energy provision are key drivers of absolute emissions but by far not the only influencing factors. To translate relative emission reduction targets into

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[24] Philibert, *Approaches for Future International Co-operation*, supra, note 4.
[25] UNFCCC, *Compilation of NAMAs*, supra, note 5.
[26] Cf. United Nations Environment Programme (UNEP), *The Emissions Gap Report 2013*, (Nairobi: UNEP, 2013); Climate Action Tracker, <http://climateactiontracker.org/countries.html> (last accessed 18 November 2013).
[27] Kyoto Protocol to the United Nations Framework Convention on Climate Change – Annex B, Kyoto, 10 December 1997, in force 16 February 2005, 37 *International Legal Materials* (1998), 22.
[28] Decision No. 406/2009/EC adopted jointly by the European Parliament and the Council on the Effort of Member States to Reduce Their Greenhouse Gas Emissions to Meet the Community's Greenhouse Gas Emission Reduction Commitments up to 2020, 23 April 2009.
[29] Niklas Höhne et al., "National GHG Emissions Reduction Pledges and 2°C: Comparison of Studies", 23 *Climate Policy* (2012), 356.
[30] The effectiveness of quotas and feed-in tariffs has for example been analysed by the European Commission in *The Support of Electricity from Renewable Energy Sources - Commission Staff Working Document*, SEC(2008) 57.

absolute emissions outcomes, projections will have to be made under certain assumptions regarding concomitant factors. A degree of uncertainty will thus always remain. Even more uncertain is the environmental outcome of conduct-based commitments since the number of influencing factors covered by the commitment is even lower. The commitment covers only the specific policy or policies but not other emission driving factors, such as economic, population and technological development, changes in fuel prices etc. Projecting emission impacts of policies requires making assumptions on the future trajectories of these macro trends, and their actual development may strongly deviate from the ex ante assumptions.

However, this lack of ex-ante clarity must not be confused with a lack of stringency or effectiveness. Very specific commitments can be chosen to be very stringent while absolute emission targets can be very lax. And very aggregate commitments may equally fall victim to unexpected development of the less controllable influencing factors such as economic development or fuel prices. The third trading period of the European Emission Trading Scheme (EU ETS) provides an illustrative example. While the reduction target of the ETS was initially perceived as reasonably stringent, the deep economic depression of many European countries has resulted in a large oversupply of allowances, drastically reducing the cost of compliance with the set target.[31]

The effectiveness of all approaches thus depends on the share of emissions covered and the ambition of the targets or policies. In principle, managing an ensemble of targets or policies in concert can be as effective as an overall target if their interaction is taken into account appropriately. When it comes to implementation, a country-wide target anyway has to be broken down to individual sectors and be implemented through a number of policies.

A bundle of disaggregated commitments could arguably even be more effective than an aggregate commitment: If an aggregate commitment turns out to be too ambitious and it becomes clear that for whatever reason it is no longer possible to comply with it, a country could capitulate before the task and stop any further mitigation efforts. Instead, under disaggregated commitments it could be reasonable from a political economy perspective for a government to abandon only the most daunting commitments and increase the effort in the more achievable ones. Thereby a government could avoid a complete failure, communicate its (partial) successes and achieve at least some commitments.

Experience also seems to suggest that countries are willing to adopt other types of commitments such as renewables and energy efficiency targets that are more ambitious than the emission targets they are combined with. For example, the European Commission projects that achieving the EU's renewable and energy efficiency targets would lead to emission reductions of 25% rather than only 20%.[32] China may offer a similar example. According to analysts the 15% non-fossil energy target it pledged under the Cancún Agreements is more ambitious than its emission intensity target.[33] As discussed in the section on institutional feasibility (section III.4), the reason is probably that countries have an inherent interest in promoting energy efficiency and other technologies, while apparently hardly any countries consider it to be in their national interest to reduce their emissions.

Commitments for strategic advancement of technologies probably face the highest degree of uncertainty with respect to what their outcome in terms of emission reductions will be since it

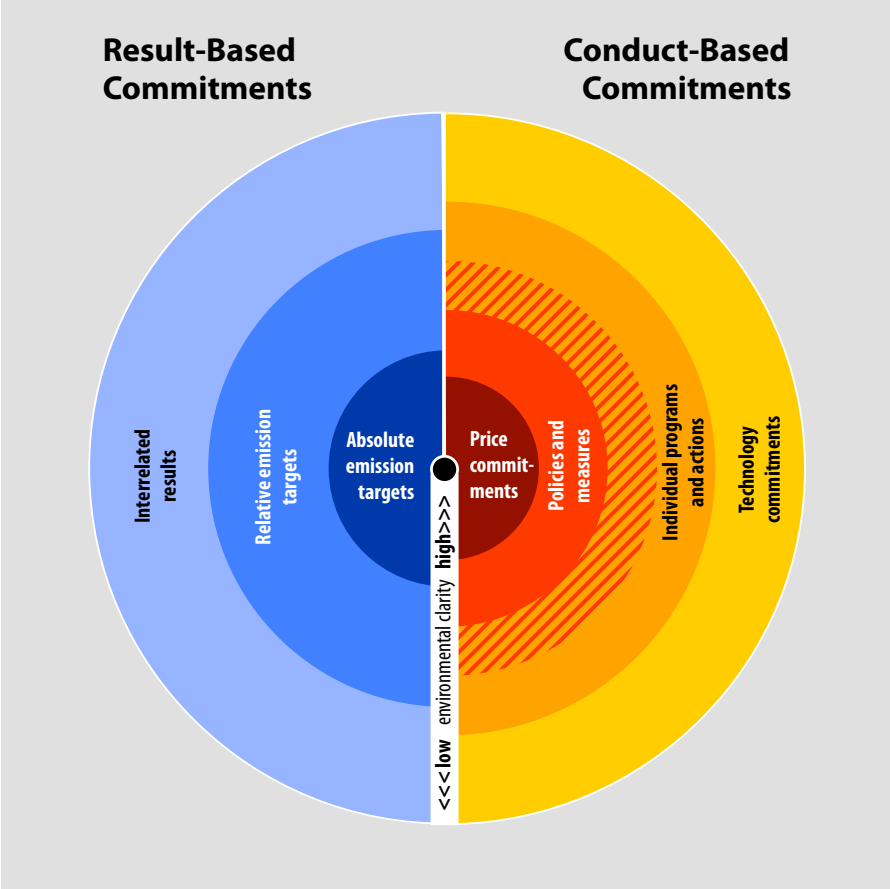
[31] Commission Staff Working Document, *Analysis of Options Beyond 20% GHG Emission Reductions: Member State Results*, SWD(2012) 5 final.
[32] Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee, and the Committee of the Regions. A Roadmap for Moving to a Competitive Low Carbon Economy in 2050, COM(2011) 112 final.
[33] Hanna Fekete et al., *Emerging Economies – Potentials, Pledges and Fair Shares of Greenhouse Gas Reduction*, (Dessau-Roßlau: German Federal Environment Agency, 2012).

is hard to forecast how successful the technology development efforts will actually be. However, the adoption of technology standards by a critical mass of countries may be sufficient to ensure global diffusion, spurring the necessary transformational change.[34]

Investments in individual actions and projects may have strong impact locally, but are not likely to achieve the necessary sector-wide transformations, except for very small countries.

In summary, absolute emission limitation or reduction obligations have been preferred in the past partly because of their relative ex-ante clarity of what environmental effect is to be achieved. This clarity is, however, not to be mistaken with environmental effectiveness. Other types of commitments provide less ex-ante clarity in terms of emission reductions, but could potentially prove more environmentally effective due to higher institutional feasibility, as also discussed further below. The main types of commitments are illustrated in Figure 1 below organized by the commitment category they fall in and their respective ex-ante clarity.

Figure 1: Main types of commitments by category. Commitment types that provide greater ex-ante clarity are closer to the centre of the graphic



2. Cost Effectiveness

In theory, the more aggregate a commitment is, the more flexibility there is to reduce emissions where costs are lowest. Price-based mitigation instruments have a reputation of effectively identifying low-cost mitigation potentials and equalising marginal abatement costs

[34] Philibert, *Approaches for Future International Co-operation*, supra, note 4.

for all covered sectors.[35] This applies both for emission price commitments as well as for emission reduction/limitation commitments if used as basis for establishing emission trading systems. In practice, however, price signals alone will often not be able to mobilise the full mitigation potential. There are many non-price barriers that stand in the way of the necessary investment decisions or behavioural change, such as risk aversion against new solutions, split incentives, lack of information and technical capacity, personal preferences etc. Such barriers continue to block the development of a huge mitigation potential, specifically energy efficiency measures that are profitable already today. According to the International Energy Agency (IEA), the no-regret potential from energy efficiency would by itself be sufficient to achieve a peak of global energy-related CO_2 emissions before 2020 and even in 2030 could still account for half of the reductions that would be necessary to stabilise atmospheric GHG concentrations at 450ppm CO_2-eq.[36]

In addition, national distribution of effort is in practice often more strongly influenced by lobbying rather than the aim of maximizing cost effectiveness, as seen for example in the cap setting and allocation of emission allowances in the EU ETS.[37]

Furthermore, country-wide emission targets and emission pricing may entail a risk that the focus of action is laid on short-term rather than long-term considerations and hence dynamic cost-effectiveness is not met. For example, new technologies may be neglected which in their infancy have high costs but may ultimately become the most cost-effective option.[38] Also, some solutions such as the re-organisation of urban settlement structures and transport systems as well as industry or power generation infrastructure need a very long time to be fully implemented; implementation therefore needs to start now to achieve the desired reductions by 2050 in a cost-effective manner.[39]

When it comes to individual technologies, such dynamic effects could be addressed through commitments for strategic technology advancement, that is, collaborative efforts to further develop mitigating technologies, to accelerate the deployment and/or increase the diffusion of such technologies, for example by means of international technology standards or commitments for (joint) research and development. International technology standards would also allow to harness network externalities, by which a country's benefit from adopting a certain standard increases in line with the number of other countries adopting the same standard.[40]

More disaggregated commitments such as sector-based emission commitments, commitments on the basis of interrelated results and commitments to implement certain policies typically allow to calibrate actions according to specific needs of sectors regarding short-term and long-term costs, implementation timelines etc. However, they do not allow equalisation of marginal abatement costs and thus reduce the ability to compensate between sectors with higher and lower cost.

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[35] Arthur C. Pigou, *The Economics of Welfare*, (London: Macmillan, 1920).

[36] International Energy Agency, *World Energy Outlook 2012*, (Paris: Organisation for Economic Development and Cooperation/International Energy Agency, 2012). The report also includes a detailed analysis of the barriers that inhibit the mobilisation of this potential and what policies and measures could be used to overcome these barriers.

[37] See e.g. Nils Anger, Christoph Böhringer, and Ulrich Oberndorfer, *Public Interest vs . Interest Groups : Allowance Allocation in the EU Emissions Trading Scheme. ZEW Discussion Paper 08-023* (Mannheim: Centre for European Economic Research, 2008).

[38] Michael Weber and Christian Hey, "Effektive und effiziente Klimapolitik: Instrumentenmix, EEG und Subsidiarität". *92 Wirtschaftsdienst* (2012), 43.

[39] Adrien Vogt-Schilb and Stéphane Hallegatte, *Marginal Abatement Cost Curves and the Optimal Timing of Mitigation Measures* (Paris: CIRED, Washington, DC: World Bank, 2013).

[40] Barrett and Toman, "Contrasting Future Paths", supra, note 16.

The cost effectiveness of individual actions may be very positive or very negative depending on the design of the individual project.

3. Distributional Effects

Compared to other options, country-wide emission targets are the least complex and hence probably the easiest commitment option to calibrate internationally according to equity considerations. However, since countries have full flexibility on where to reduce emissions, there is a risk that they may largely or fully exempt sectors that face international competition from reduction obligations or carbon prices by lowering other taxes or introducing new subsidies. National targets that have comparable stringency and even an internationally uniform carbon price would therefore not automatically constitute a "level playing field" for internationally competing industries. Calibrating efforts at sector level, instead, would allow to internationally co-ordinate mitigation actions in sectors that are competing internationally. In addition, due to national and international differences in capacity to pay, a uniform carbon price is socially regressive. Treating dissimilar cases alike is as inequitable as treating similar cases differently.[41]

Commitments to strategically advance technologies may also have distributional impacts. Generally, all countries would profit from the application of more efficient technologies. However, strong international technology standards might create new or increase dependencies between technology exporters, which are usually a small number of countries, and technology importing countries.[42] Hence, technology standards could benefit more advanced, technology exporting countries over those who have to import these. On the other hand, the proliferation of renewable energy and energy efficient technologies can reduce dependence on other resources, particularly fossil fuels, and thus yield benefits for technology importers as well.[43]

Furthermore, many mitigation options do not require highly capital intensive and technologically advanced technologies, especially when it comes to sustainable agricultural practices.[44] If technology transfer is understood comprehensively, it includes not only the transfer of technological hardware but also the transfer of embedded knowledge to allow the recipients to fully adopt the technologies and adapt them to their respective necessities. If technology transfer is achieved in this comprehensive sense, it can lead to significant sustainable development benefits in the receiving countries.[45]

Assessing distributional effects of PAMs is difficult as it must be done on a case-by-case basis. With a PAM-based approach, probably at best a qualitative international calibration of levels of effort would be possible.

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[41] Aviel Verbruggen, "A Turbo Drive for the Global Reduction of Energy-Related CO_2 Emissions", 3 *Sustainability* (2011), 632.

[42] Antoine Dechezleprêtre, Matthieu Glachant and Yann Ménière, *What Drives the International Transfer of Climate Change Mitigation Technologies ? Empirical Evidence from Patent Data* Grantham Research Institute on Climate Change and the Environment Working Paper No. 14. (London: Grantham Research Institute on Climate Change and the Environment, 2009).

[43] Ottmar Edenhofer, Ramón Pichs Madruga and Youba Sokona (eds.), *Renewable Energy Sources and Climate Change Mitigation: Special Report of the Intergovernmental Panel on Climate Change* (New York: IPCC, 2012), at 718-728.

[44] Beverly D McIntyre, Hans Herren, Judi Wakhungu and Robert T Watson (eds.), *Agriculture at a Crossroads – Synthesis Report*. (Washington, D.C.: International Assessment of Agricultural Knowledge, Science and Technology for Development, 2009).

[45] Rob Byrne, Adrian Smith, Jim Watson & David Ockwell, *Energy Pathways in Low-Carbon Development: From Technology Transfer to Socio-Technical Transformation.* (Brighton: STEPS Centre, 2011), at 22-23.

4. Institutional Feasibility

Country-wide emission targets give countries flexibility on where to reduce emissions and thus allow tailoring of national policy according to national preferences, which minimises possible concerns about infringement of sovereignty. This was one of the main reasons why the Kyoto Protocol followed the targets and timetables approach and the discussions about coordinating policies and measures remained inconclusive.[46]

However, with a focus on overall national ambition, national discussions may be stymied by competitiveness concerns of some industries even though they may account only for minor shares of total national emissions. In addition, transforming emissions into a scarce and thus valuable commodity arguably exacerbates the distributional controversy among countries on who should contribute how much to the global effort. Stiglitz opines that, *"If emissions were appropriately restricted, the value of emission rights would be a couple trillion dollars a year – no wonder that there is a squabble over who should get them."* [47] Participation of some key countries has in the past essentially been bought by allocation of substantial surplus allowances.[48] This approach is not compatible with the requirement of steep global reductions.

Absolute emission targets are also risky for governments as there is substantial uncertainty on what the costs of mitigation options really are. In addition, key emission drivers such as economic and population development are largely beyond government control.[49] Given the historically strong link of economic activity and emission levels, absolute emission targets are often perceived as a potential "cap on development" or "limiting development space".[50] This incentivises weak targets and/or "safety valves" such as offsetting mechanisms to minimise the risk of a cost explosion. Hence, there is a risk of reaching only the lowest common denominator.

Relative emission targets can partially address these concerns as the emission target is a function of economic development. All emerging economies have in fact pledged relative targets for 2020, either in terms of emission intensity or in terms of a relative deviation from business as usual.[51]

With regards to emission price commitments, the proponents maintain that these would not be a tax commitment. An international price commitment could be implemented in various ways nationally, through a tax or through an emission trading system with a minimum price, so there would be some flexibility for countries on how exactly to implement the international price commitment nationally.[52] Policy-makers are nonetheless likely to see this approach as an attempt to harmonise taxation, and taxation issues are usually seen to be at the core of

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[46] Michael Grubb, Christiaan Vroljik and Duncan Brack, *The Kyoto Protocol. A Guide and Assessment* (London: Royal Institute of International Affairs, 1999); Sebastian Oberthür and Hermann E. Ott, *The Kyoto Protocol. International Climate Policy for the 21st Century* (Berlin: Springer, 1999).

[47] Joseph E. Stiglitz, "Overcoming the Copenhagen Failure", 6 January 2010, available on the internet at <http://www.project-syndicate.org/print/overcoming-the-copenhagen-failure> (last accessed on 29 November 2013). Stiglitz makes the same argument in more detail in Stiglitz, *Making Globalization Work*, supra, note 23.

[48] Grubb et al., *Kyoto Protocol. A Guide and Assessment*, supra, note 19; Oberthür and Ott, *The Kyoto Protocol. International Climate Policy*, supra, note 19.

[49] Victor, *Global Warming Gridlock*, supra, note 10.

[50] William Moomaw and Mihaela Papa, "Creating a Mutual Gains Climate Regime through Universal Clean Energy Services", 12 *Climate Policy* (2012), 505.

[51] UNFCCC, *Compilation of NAMAs*, supra, note 5.

[52] Peter Cramton, Axel Ockenfels, and Steven Stoft, "How to Negotiate Ambitious Global Emissions Abatement. A Statement of Key Principles and an Explanatory Note", 30 May 2013, available on the Internet at <http://www.cramton.umd.edu/climate/files/2013/05/GCP-Project-statement-exlanatory-note.pdf> (last accessed 3 December 2013).

national sovereignty. One reason why the PAM approach failed in the 1990s was that it was seen as an attempt to harmonise energy taxation.[53]

A general advantage of more disaggregate commitments is that they can be agreed in a sequential manner. This allows for policy makers to make use of the political momentum more flexibly. Approaches based on sectors, interrelated results or policies could allow actions to move forward in some sectors without being held back by problems in other sectors. At the same time compliance mechanisms that are geared towards individual sectors could generate more targeted incentives and might be easier to agree than compliance mechanisms addressing the entire country.[54] On the other hand, individual parts of a bundle of commitments can be scrapped more easily if the political momentum turns into a head wind for some reason.

Commitments on interrelated results and/or specific policies do not transform emissions into a valuable resource and may thus generate less perverse incentives to set weak commitments. Non-emission based approaches may also generate less fear of becoming a "cap on development". Developing countries have traditionally maintained that development and poverty eradication are their overriding priorities. Non-emission-based commitment types arguably have better potential to marry development and climate objectives, the key rationale behind the SD PAMs proposal, since they may aim at climate-relevant items governments aspire to also for other reasons, such as improving energy efficiency or promoting certain technologies. They are also less risky than emission targets as governments can typically influence interrelated results such as scale-up of certain technologies or efficiency improvements more directly than emission outcomes. As noted above, some Parties such as China and the EU have non-emission targets that are more ambitious than their related emission targets.

From the purely technical perspective, delivery of policy commitments does not entail any risk of non-compliance as policy implementation is fully under the control of parliaments and governments, as opposed to the results of those policies. Victor therefore argues that commitments should be based on what governments actually do, which is implementing policies.[55] Ensuring that the bundle of policies and measures is in line with the required level of ambition is, however, a more complex task. For individual actions and projects this holds true even more.

And while a PAM-based approached entails little technical risk of compliance failure, it may as noted face strong political opposition nationally and internationally. International negotiation of policies would also be more complex than negotiation of emission targets, especially if not only broad headlines but also details of specific PAMs were to be coordinated. Victor maintains that this is indeed the adequate level of complexity, given that climate negotiations are effectively economic negotiations. He argues that the WTO is therefore a much more appropriate model for the climate regime than the Montreal Protocol or other environmental agreements. While these agreements usually only affect very small segments of countries' economies, combating climate change requires a fundamental re-orientation of countries entire development pathways. And the WTO does coordinate policies and measures, such as tariffs, subsidies or government procurement, at a very high level of very prescriptive detail, so sovereignty concerns are apparently not an insurmountable barrier. Victor therefore suggests an approach similar to the WTO accession process, with countries tabling contingent offers to implement specific climate PAMs and on this basis negotiating

[53] Grubb et al., *Kyoto Protocol. A Guide and Assessment*, supra, note 19; Oberthür and Ott, *The Kyoto Protocol. International Climate Policy*, supra, note 19.
[54] Barrett and Toman, "Contrasting Future Paths", supra, note 16.
[55] Victor, *Global Warming Gridlock*, supra, note 10.

mutually acceptable packages of PAMs for each country, including provision of financial and other support by wealthy to poor countries.[56]

On the other hand, the PAM approach was tried and did fail in the Kyoto negotiations. The difference can probably be explained by the fact that countries see direct benefits for themselves in trade negotiations while in the climate regime there is no such possibility of a direct quid pro quo. As Bodansky notes, the result is that in the climate regime most countries have so far been "more concerned about binding themselves than they have been desirous of binding others."[57]

With respect to technology agreements there is not much experience available at international level, especially not at the required scale. Agreeing joint R&D for mitigation technologies yields direct positive benefits for participating countries and could therefore be relatively easy to achieve. For the distributional reasons discussed above, it could be more difficult to agree on international technology standards. Transnational sectoral approaches have in fact in the past been strongly rejected by non-Annex I countries as an attempt to impose foreign standards.[58] In addition, the debate on standard setting in the EU suggests that many of the proposed standards are strongly contested by the affected industry groups. For example, the German government in the summer of 2013 insisted on re-opening an already concluded agreement to regulate CO_2 emissions from new cars due to intensive lobbying by the German car industry.[59]

IV. Conclusions

Table 1 summarises the above discussion on the main advantages and disadvantages of each type of commitment.

The analysis suggests that there is no silver bullet, each approach has its strengths and weaknesses. While emission-based approaches provide environmental clarity, the potential to maximise cost-effectiveness and political flexibility, they are not inherently politically attractive. To the contrary, emission targets are frequently associated with constraining "development space" and posing risks to economic development and employment. Comparable country-wide emission targets also do not automatically constitute a "level playing field" for internationally competing industries as governments are free to largely or fully exempt these industries from emission reduction obligations.

The other approaches may be politically more attractive since they might generate less fear of constituting a "cap on development" and many countries have an inherent interest to promote energy efficiency or certain technologies. Non-emission-based commitment types therefore arguably have better potential to marry development and climate objectives, the key rationale behind the SD PAMs proposal. While sustainable development benefits are usually referred to as "co-benefits" in the climate regime, for developing countries they are clearly the main benefits. The same arguably holds for the traditional industrialised countries. When looking at climate-related legislation such as the German Renewable Energy Act, it lists four objectives that are to be achieved. And only one of these relates to climate and the environment, the

[56] Ibid.
[57] Daniel Bodansky, "The Durban Platform Negotiations: Goals and Options", July 2012. Available on the Internet at http://belfercenter.ksg.harvard.edu/publication/22196/durban_platform_negotiations.html (last accessed 3 February 2014..
[58] Observed personally by the authors while attending UNFCCC negotiations.
[59] Damian Carrington, "Angela Merkel 'Blocks' EU Plan on Limiting Emissions from New Cars", 28 June 2013, available on the Internet at <http://www.theguardian.com/environment/2013/jun/28/angela-merkel-eu-car-emissions> (last accessed 26 November 2013).

other three are immediate benefits the German legislator hopes to achieve: Reducing the long-term macro-economic cost of energy supply, preserving fossil energy resources and promoting technology development.[60] The climate regime would arguably profit from recognising that climate change is far from being the only rationale driving emission reduction policy. Non-emission based approaches may also have the advantage of disaggregating the task of reducing national emissions into smaller parts that may appear more manageable. However, they would be more difficult to judge in terms of their environmental impact and thus make it more complicated to assess the UNFCCC's overall progress towards reducing emissions. The difficulty in quantifying GHG emissions may also open a venue to countries for weakening their level of ambition.

From the perspective of environmental effectiveness, approaches that combine the strengths of the various options may be the most promising way forward, especially if these balance clarity of the committed outcome and clarity over the intended way of implementation. Real-life examples are provided by some non-Annex I pledges such as those of Brazil and China, which combine country-wide emission targets with some sectoral targets, and the EU's 20-20-20 targets on greenhouse gases, energy efficiency and renewables. Emission targets could be set as the floor for ambition and commitments on technologies or policies could support them, possibly even overachieving them. Combining emission targets with other commitment types could also help overcome the deficit of non-emission based approaches regarding environmental clarity: measuring, reporting and verification of these approaches could focus on whether they are indeed implemented while the environmental outcome could be assessed in aggregate at the level of the national emission inventory.

A multi-dimensional approach combining various types of commitments could also be more failsafe than focusing only on one single approach. If one approach falls short, as the carbon price currently does, this deficit may be compensated by the other approaches. Climate Commissioner Hedegaard recently opined that, "During the economic crisis we had more than one target and that has helped us a lot. Imagine if we had only had a CO_2 target and the ETS (Emissions Trading System) during this crisis. Would Europe have continued to have such a strong focus on energy efficiency and renewables? I don't believe it."[61]

However, if all these various dimensions were to be negotiated internationally, negotiation complexity would increase substantially. As noted, some authors argue that this is exactly the required level of complexity, given the complexity of the climate problem, and suggest the WTO as an example to follow. These authors suggest that countries should table contingent offers to implement specific climate PAMs and negotiate mutually acceptable packages of PAMs for each country, including provision of financial and other support by wealthy to poor countries.

Still, the WTO did not attain its current level of complexity in just a few years. The international trade regime started out more than six decades ago as a rather modest General Agreement on Tariffs and Trade. And the political incentives are different as governments see the potential for direct benefits in the trade negotiations but apparently not in the climate negotiations. In the climate regime, countries have in the past been strongly allergic to co-ordinating policies and measures internationally, as is being done in the WTO.

[60] Erneuerbare-Energien-Gesetz vom 25. Oktober 2008 (BGBl. I S. 2074), das zuletzt durch Artikel 5 des Gesetzes vom 20. Dezember 2012 (BGBl. I S. 2730) geändert worden ist, http://www.gesetze-im-internet.de/eeg_2009/, last accessed 3 December 2013.

[61] Quoted in: EurActiv.com, "Hedegaard: More 2030 Climate Targets Would Be 'Wise'", 10 October 2013, available on the Internet at <http://www.euractiv.com/energy/hedegaard-2030-climate-targets-w-news-530979> (last accessed 29 November 2013).

It also does not seem likely that countries would be willing to agree on a list of commitment types that would be mandatory for all countries. The EU in the ADP suggested that a "spectrum of commitments" that would match certain commitment types with certain country groupings should be developed. However, many countries were defensive or even openly hostile against having any kind of international processes determine or assess what they should do. As a result, the latest ADP decision stipulates that "contributions" will be "nationally determined".[62]

Nonetheless, based on the findings from this article countries should at least be strongly encouraged to think about the future climate regime more multi-dimensionally than only in terms of GHGs. Many of the Cancún pledges from non-Annex I countries are multi-dimensional and the same may be the case for their 2015 contributions. The climate regime may thus incrementally expand its scope to better marry countries' development and climate objectives than it has done so far.

[62] Decision -/CP.19, Further Advancing the Durban Platform, Advance unedited version, available online at <https://unfccc.int/files/meetings/warsaw_nov_2013/decisions/application/pdf/cop19_adp.pdf>, last accessed 3 December 2013.

Table 1: Summary Assessment of Commitment Types

	Environmental Effectiveness	Cost-effectiveness	Distributional Considerations	Institutional Feasibility
Economy-wide Emission targets	+ Highest ex ante clarity - If tradable and bankable, minimum = maximum reduction, may stifle dynamic	+ Maximum flexibility - Risk of focusing on low-hanging fruit, neglecting long-term perspective, ignoring options that face non-price barriers	+ Easiest option to calibrate internationally - Risk that governments may exempt sectors facing international competition - If tradable and bankable, exacerbates distributional controversy	+ Maximum flexibility +/- Feasibility differs among sectors - Absolute targets arguably risky for governments, relative targets less so
Sectoral Emission Targets	See above	+ Allows calibration of actions to sectoral needs - No equalisation of marginal abatement costs	+ Efforts would be co-ordinated at sector instead of country level, may help to address competitiveness concerns	+ Helps to deal with differences in feasibility among sectors + Compliance may address individual sector rather than entire country - More complex negotiations - Transnational sector approach in past strongly rejected by non-Annex I
Targets for Interrelated Results	- Emission outcome can be projected but with uncertainty	+ Allows calibration of actions to sectoral needs - No equalisation of marginal abatement costs	+ Efforts would be co-ordinated at sector instead of country level, may help to address competitiveness concerns	+ Helps to deal with differences in feasibility among sectors + Compliance may address individual sector rather than entire country + Many countries have strong interest to promote certain technologies + Interrelated results easier to influence than overall emissions + No incentive to maximise emission allocation - More complex negotiations
Emission Price Commitments	+ Direct reduction incentive - Emission outcome can be projected but with uncertainty - Emission pricing no panacea	+ Marginal costs equalised from outset on - Risk of focusing on low-hanging fruit, neglecting long-term perspective	- Uniform emission price does not automatically constitute level playing field - Uniform price is socially regressive	+ Delivering policy inputs easier than delivering certain outcomes + No incentive to maximise emission allocation - Taxation lies at core of national sovereignty
Technology-Oriented Agreement(s)	+/- May be high but difficult to predict + Adoption of standards by critical mass sufficient to ensure global adoption - Not all sectors amenable to international standards	+ Allows calibration of actions to sectoral needs - No equalisation of marginal abatement costs + Allows to harness network externalities	+/- May strongly favour technology exporters, but provides incentives to enhance development and share information	+ Delivering policy inputs easier than delivering certain outcomes + No incentive to maximise emission allocation + Direct positive benefits for participating countries - Transnational sector approach in past strongly rejected by non-Annex I
Packages of PAMs	+ Direct reduction incentives - Emission outcome can be projected but with uncertainty	+ Allows calibration of actions to sectoral needs - No equalisation of marginal abatement costs	- Probably at best qualitative international calibration possible	+ Delivering policy inputs easier than delivering certain outcomes + No incentive to maximise emission allocation - More complex negotiations
Individual Actions and Projects	- May be strong at project level but usually no transformative sectoral impact	+/- May be positive or negative at project level - No equalisation of marginal abatement costs	+/- Depends on individual project and finance	May be most adequate for countries with low capacity